

CHOOSING THE BEST POSITION FOR INSTALLING THE SURVEILLANCE SYSTEMS

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ABSTRACT

Widespread use of intelligent transportation systems necessitates guidelines for choosing the best position for installing the intelligent transportation subsystems. Surveillance systems are very important among the intelligent subsystems.

In this paper a guide line for choosing the best position for installing the surveillance systems in harmony with other intelligent subsystems on a specified road is introduced. A survey between managers and technicians of ministry of roads and transportation of Iran is conducted to determine the main goals of using surveillance systems and suitable measure of performance and their importance weights. A work sheet is then prepared which shows important characteristics and their weights. Level of surveillance for a specific road can be determined using the characteristics of that road. Three level of surveillance are defined. There is a list of important points for each level of surveillance.

After choosing the important points on the considered road, their exact position and characteristics of the camera must be determined. The proposed guide line is used for a rural road in Iran and its advantages have been shown.

Key words: Intelligent Transportation Systems, Positioning, Surveillance.

1- INTRODUCTION

Surveillance means observation at a definite time and place. So, operating a surveillance system via Intelligent Transportation System (ITS) means, preparing a situation for traffic observation for the sake of traffic management, demand management, informative services, and so on[1].

Advanced Traffic Management Systems mostly consist of the two different subsystems for traffic observation in highways; Traffic sensors and Closed Circuits Television (CCTV). These two subsystems prepare real time data from traffic situation for Traffic Operation Center (TOC). Images obtained from CCTVs also provides operator to access traffic situation independently. Noticeable developments of image processing technology have increased application of surveillance system [2].

There are many researches that have been done about monitoring systems in Iran. For example reports of ministry of roads and transportation, Tehran Traffic Control Center (TTCC), Police and other related organizations [3]. There are many researches for calculating the benefits and cost of using surveillance systems in other countries that results to different amount of benefits [4,5]. In these researches, it is shown that the benefit of using a system is a dependant of the position and situation of the site., It is shown that, when the suitable sites are chosen for monitoring, benefits are increased. This fact necessitates preparing a guideline for choosing the best positions for using the monitoring systems.

Objective of this project is providing instructions for application of surveillance system (Detect & Control) in a corridor using appropriate technology according to other ITS features. In other word, goal of this project is “presentation of a collection of executive instructions related to location of surveillance systems and appropriate technology as using these instructions would increase transportation performance in various fields and satisfy needs of users and suppliers”.

2. PREPARATION OF GUIDELINE

A sample of researchers and technicians is chosen in the road and transportation ministry and university faculties for preparing a guideline for choosing the best position for installing the surveillance systems. According to researches and expert opinions, respected visions of surveillance system will be defined. For achieving these visions, some goals are defined and for achieving those goals, some operational objectives are planned. By using expert opinions via questionnaires these objectives are localized. In this way, instructions for locating facilities are prepared to satisfy these objectives. Procedure of research is shown in figure 1.

In order to achieve goals and objectives, following aspects in preparation of instructions should be noticed:

- 1- Instructions should be inclusive to include all subjects.
- 2- All instructions should have harmony with each other
- 3- All objectives and goals should be noticed in all steps of project.

For recognizing places for surveillance system, foreign researches and experiences were used. Mean while for localizing these researches, it's referred to opinion for local experts specially police staff. Opinions of these experts were gathered through questionnaires and evaluated. At last combining these two sources, important places for applying surveillance system have been defined in instructions studying of applications of surveillance system in other countries showed that this system has various applications in various places. Some of these places are:

Main corridors, strategic places and intersections, high volume roads, high accident probability points, entering ramps to the high ways and roads, bridges, tunnels, rest zones, under construction areas in highways, stormy path, bad weather condition roads, major intersections, endpoint of bridges, border roads, freight terminals, mountain road, HOV lanes, bus specific lanes and vehicle maintenance zones.

For defining appropriate applications in Iran, first visions, goals and objectives of this system defined. In the way that applications should satisfy these visions, goals and objectives. Questionnaire designed in two sections, first visions, goals and objectives and second

technology. At the first section (visions, goals and objectives) opinion of experts in this field were asked. At the technology section, experts were asked to define short term and long-term surveillance technologies regarding to current facilities and infra constructions.

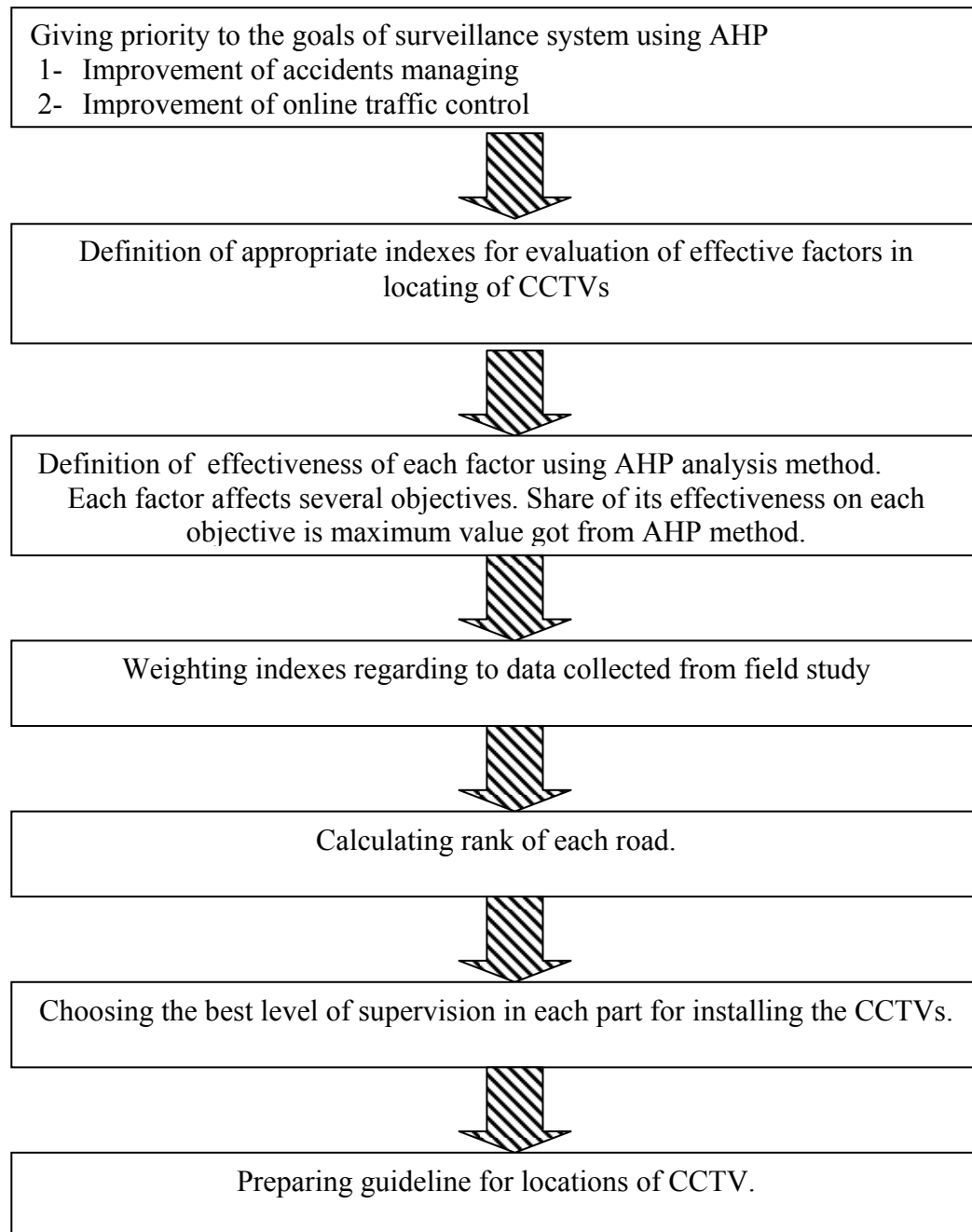
After evaluation of questionnaires, vision of this study defined as bellows:

“Preparing trip and traffic information, on the major corridors to provide safety and network performance for cargo and passengers transportation”

For applying best monitoring, complete Instructions regarding to all of factors should be prepared. Harmony between parts of this system is second important issue and in all steps of preparing instructions, it's assumed that vision of study should be satisfied.

For these purpose appropriate indexes for measuring factors, that affect location of CCTVs and their effectiveness, are defined. These indexes are defined regarding to expert's opinion and AHP analysis method. Then regarding to data collected from field study, these indexed are weighted. The proposed guideline is prepared regarding the value of the indexes. Figure 1 shows process of preparing the proposed guideline.

Fig (1): Process of preparing instructions



Goals and related objectives that are defined using the questionnaire are presented in the below table. After choosing the goals and objectives, indexes are determined and weighted.

Table (1). Goals and related objectives

<p>1- Improvement of accident managing</p> <p>Preparing data for automated accident recognition.</p> <p>Identification of damaged vehicles.</p> <p>Evaluation of accident report.</p> <p>Evaluation of accident severity.</p> <p>Preparing data for way of dealing accidents.</p> <p>Tracing of dangerous goods.</p>	<p>5- simplifying of transportation demand management (TDM)</p> <p>Definition of congested situations.</p> <p>Definition of V/C levels in various times of a day.</p> <p>Air quality control</p> <p>Estimation of moved passengers.</p>
<p>2- Improvement of online traffic control</p> <p>Ramp metering in highway network.</p> <p>Supporting of online traffic control.</p> <p>Creating a system to give priority to HOVs.</p> <p>Give priority to vehicles in signalized intersections and railway intersections.</p> <p>Definition of speed limit regarding to traffic situation.</p> <p>Support pricing of restricted areas.</p>	<p>6- Improvement of multimode transportation</p> <p>Tracing of passengers vehicles and their schedule.</p> <p>Preparing data from transit corridors.</p> <p>Trip time estimation for passenger vehicles.</p> <p>Evaluation of park rides situation.</p> <p>Monitoring of passenger's safety in stations.</p>
<p>3- Supporting the rules enforcements.</p> <p>Speed metering.</p> <p>Vehicle weighting.</p> <p>Measuring of vehicles dimensions.</p> <p>Measuring of vehicles occupancy.</p>	<p>7- creating data banks for transportation planning.</p> <p>Traffic counting.</p> <p>Vehicle kilometers data.</p> <p>Combination of vehicle types.</p> <p>Delay information.</p> <p>Origin – destination data.</p> <p>Accidents data (place, type, severity, time,)</p>
<p>4- Improvement of traffic managing in emergency situations (storm,)</p> <p>Supporting of traffic control regarding environmental conditions.</p> <p>Supporting services for planning and snow off routines.</p>	<p>8- supporting information services to passengers.</p> <p>Preparing traffic data (congestion, accident, etc.)</p> <p>Preparing path data (ice, snow, etc.)</p> <p>Preparing parking data in destination or park ride.</p> <p>Preparing data for intercity passengers (time of reaching, etc)</p>

In this method, hierarchy structure was goals, objectives, and indexes. Index weights are calculated by expert opinion in questionnaires. After weighting the indexes, levels of monitoring regarding to weight of the chosen road and location of CCTVs installation are determined.

At level A, whole of the road needs to be monitored. At level B, CCTVs are installed in places which the main objectives of monitoring are satisfied. These places are listed in list B.

At level C, CCTVs are installed in the places which are listed in list B, and at the level of D, there are no need to traffic monitoring.

Table (2): Work sheet for determining the level of surveillance

Rank	Value				Index
	value * 172		< 5		Accident rate
	860		≥ 5		
	D, E, F	C	B	A	Level of service (v/c)
	770	640	450	290	
	No		Yes		Road is a part of a main corridor
	0		575		
	No		Yes		Existence of service or recreational land use on the road side
	0		485		
	No		Yes		Existence of intersection or main access point on the road
	0		560		
	No		Yes		Existence of toll collection on the road
	0		440		
	No		Yes		Existence of intersection of rail and road
	0		385		
	Value * 12.67		< 60		Violation rate per kilometer
	760		≥ 60		
	Value *10.6		< 50		Percentage of heavy vehicles
	530		≥ 50		
	No		Yes		Existence of bridges or tunnels on the road
	0		500		
	No		Yes		Existence of checking point on the road
	0		410		
	680	<input type="checkbox"/>	Mountains with dangerous snowy turns		Climate
	590	<input type="checkbox"/>	Mountains with wet surface turns		
	420	<input type="checkbox"/>	Mountains with cold weather		
	250	<input type="checkbox"/>	Mountains with warm weather		
	210	<input type="checkbox"/>	Deserts		

Continued Table (2): Work sheet for determining the level of surveillance

Rank	Value			Index
	No	Yes		Existence of parallel roads
	0	540		
	No	Yes		Existence of accessibility to bus terminals, train station or airports the road
	0	490		
	No	Yes		Existence of fog or pollution
	0	245		
	Sum （V）			
D	C	B	A	Required level of service
V < 2000	$2000 \leq V < 4000$	$4000 \leq V < 6000$	$V \geq 6000$	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
–	List B	List A	Full coverage	Installation sites
<u>List B (ordered as their priority)</u> 1. Black spots 2. Important access point and intersections 3. important bridges and tunnels 4. Recreational and service areas 5. Toll collection 6. Checking points 7. intersection of rail and road			<u>List A (ordered as their priority)</u> 1. Black spots 2. Potential points for avalanche or flood 3. Potential points for landslip 4. Important access point and intersections 5. important bridges and tunnels 6. Access to terminals 7. Recreational and service areas 8. Toll collection 9. Checking points 10. intersection of rail and road 11. foggy or polluted places	

3- CASE STUDY

The proposed guideline is used to find the level of surveillance suitable on one of the rural roads in Iran, Karaj – Chaloos. First 20 km of this road from Karaj Amirkabir square to police station next to Amirkabir dam was chosen. After gathering needed data, work sheet of table 1 is filled as it is presented in the table 3.

Table (3): Work sheet filled for case study

Rank	Value				Index	
860	value * 172		< 5	18.33	Accident rate	
	860		≥ 5			
450	D, E, F	C	B	A	B	Level of service (v/c)
	770	640	450	290		
0	No		Yes		No	Road is a part of a main corridor
	0		575			
485	No		Yes		Yes	Existence of service or recreational land use on the road side
	0		485			
0	No		Yes		No	Existence of intersection or main access point on the road
	0		560			
0	No		Yes		No	Existence of toll collection on the road
	0		440			
0	No		Yes		No	Existence of intersection of rail and road
	0		385			
663.4	Value * 12.67		< 60	52.35	Violation rate per kilometer	
	760		≥ 60			
149.5	Value *10.6		< 50	14.1	Percentage of heavy vehicles	
	530		≥ 50			
500	No		Yes		Yes	Existence of bridges or tunnels on the road
	0		500			
410	No		Yes		Yes	Existence of checking point on the road
	0		410			
680	680	■	Mountains with dangerous snowy turns			Climate
	590	□	Mountains with wet surface turns			
	420	□	Mountains with cold weather			
	250	□	Mountains with warm weather			
	210	□	Deserts			

Continued Table (3): Work sheet filled for case study

Rank	Value			Index
0	No	Yes		Existence of parallel roads
	0	540		
0	No	Yes		Existence of accessibility to bus terminals, train station or airports the road
	0	490		
0	No	Yes		Existence of fog or pollution
	0	245		
4197.9	Sum （V）			
D	C	B	A	Required level of service
V < 2000	$2000 \leq V < 4000$	$4000 \leq V < 6000$	$V \geq 6000$	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
—	List B	List A	Full coverage	Installation sites
<u>List B (ordered as their priority)</u> 1. Black spots 2. Important access point and intersections 3. important bridges and tunnels 4. Recreational and service areas 5. Toll collection 6. Checking points 7. intersection of rail and road			<u>List A (ordered as their priority)</u> 1. Black spots 2. Potential points for avalanche or flood 3. Potential points for landslip 4. Important access point and intersections 5. important bridges and tunnels 6. Access to terminals 7. Recreational and service areas 8. Toll collection 9. Checking points 10. intersection of rail and road 11. foggy or polluted places	

As can be seen in table 3, rank of the considered road is 4197.9 and it is advisable to use level of surveillance at B for the considered road.

4- CONCLUSIONS

In this research guideline for selecting the suitable level of surveillance on the rural road is proposed. Using the proposed guideline a unique method for investigation in intelligent transportation systems is available that prevents any discriminative plan.

For future studies, it is advisable to use the above mentioned guideline and evaluate the results and report the result to the ITS experts, and then again gathered the experts opinions about the weight of indexes. In this way, the guideline can be corrected to be more reliable for different projects in different countries and different situations.

5- REFRENCCESS

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